Autolanding for Robotic Precursor Missions

Problem Statement

- Matures the Astrobotic Autolanding System (AAS) a complete system for precise, safe autonomous planetary landings. Addresses roadmap elements including auto approach & landing, sensors & vision processing, 3-D perception, and pose estimation.
- Requested flights demonstrate integrated technology on a relevant vehicle and with a relevant flight trajectory. Potential users are Precursor Robotic Missions and NASA ALHAT program as an alternate to current technology, AAS is optimized for small robotic landers and utilizes scanning LIDAR instead of flash LIDAR.

Technology Development Team

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Proposed Flight Experiment

Experiment Readiness:

- Ready for flight June 2013

Test Vehicles:

- sRLV – Masten Xaero

Test Environment:

- Previously demonstrated in autolanding of unmanned Little-Bird helicopters.
- Prior to proposed flight opportunities program, the AAS will be flown on NASA Marshall Space Flight Center’s Mighty Eagle lander in Q2 2013 to demonstrate low-altitude ops and reach TRL 5
- Requested flights demonstrate end-to-end landing with space-relevant trajectories. Flights progress from blind open-loop low altitude flight to high altitude flight with perception culminating in a full-scale end-to-end landing from 4km AGL.

Test Apparatus:

- Image below shows landing sensor on a helicopter

Technology Maturation

- TRL 5: AAS demonstrated in relevant environments; helicopter for full altitude range, Marshall Mighty Eagle lander for final descent/touchdown relevant trajectory and closed-loop
- TRL 6: end-to-end approach and landing trajectory from 4km to ground w/ relevant trajectory and closed-loop

Steps to TRL 6:

- Now-Dec 2012: Sensor and algorithm refinement
- Jan-June 2013: TRL 5 through testing on ground vehicle, helicopter, and NASA Marshall Mighty Eagle
- Oct-Dec 2013: TRL 6 through proposed Flight Opportunity project on Masten Xaero

Objective of Proposed Experiment

- Demonstrate end-to-end closed-loop safe, precise landing with space-relevant trajectories.
- Data from the requested flights confirm estimation accuracy, hazard detection rate, and hazard detection resolution in end-to-end full-scale flights.

TA05.4.7 Auto Approach and Landing; TA09.3.4 Landing GNC for Large Bodies; TA05.4.4 Sensors & Vision Processing Sys; TA04.1.1 3-D Perception; TA04.1.2 Relative Position & Velocity Estimation; TA05.4.3 Onboard Auto Nav. & Maneuvering